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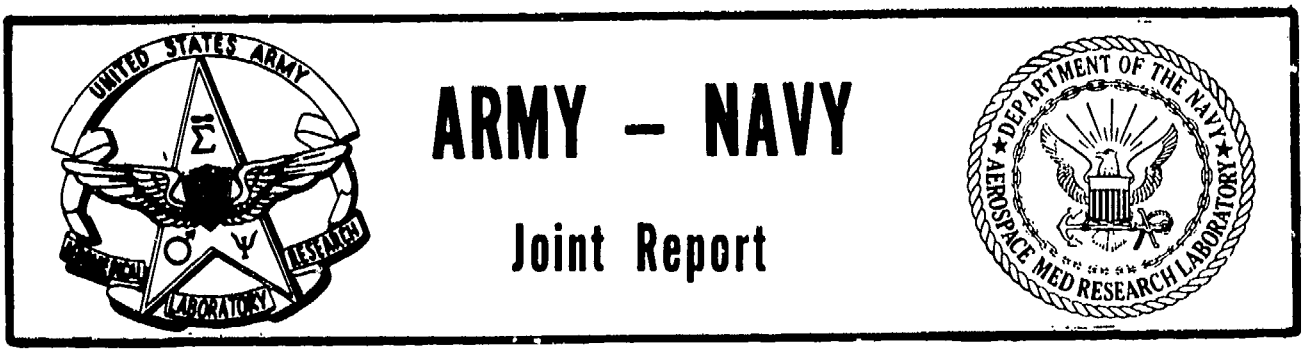

U. S. ARMY AEROMEDICAL RESEARCH LABORATORY

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY

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THE EFFECT OF PERFORMANCE RELEVANCE AND FEEDBACK UPON RESISTANCE TO ANTICIPATORY STRESS

Xenia Coulter

Bureau of Medicine and Surgery
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U. S. Army Aeromedical Research Laboratory

Approved by

Ashton Graybiel, M. D.
Assistant for Scientific Programs

Released by

Captain N. W. Allebach, MC, USN
Officer in Charge

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Naval Aerospace Medical Research Laboratory
Naval Aerospace Medical Institute
Naval Aerospace Medical Center
Pensacola, Florida 32512

SUMMARY PAGE

THE PROBLEM

In a threatening situation, the occurrence of harm may depend upon performance (relevance), and if information is supplied regarding performance quality (feedback), the probability of harm (stress magnitude) may be altered. However, relevant situations do exist in which probabilities cannot be realistically changed. The present study sought to demonstrate that in a relevant situation, with feedback, the ability to resist stress would be enhanced even though stress magnitude remained the same. The study also sought to determine whether relevance and feedback would have any effect in a nonthreatening situation.

FINDINGS

Significant stress resistance was observed when performance was relevant to the occurrence of harm and when information was also supplied regarding performance quality. Stress resistance was also observed in the nonthreatening situation, which suggests that anticipatory physical threat stress may be only one instance of anticipatory stress per se. In addition, stress level was shown to be measurable in terms of performance variability and was related to performance level by means of a U-shaped function, which suggests that performance level may reflect motivational aspects of stress. Three types of performance measures (shape, level, and variability) were shown to be useful for measuring different effects of stress.

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INTRODUCTION

Those engaged in hazardous enterprises need to know how the threat of physical harm may affect their work and whether there is any way to resist aversive stressful effects. Wherry, Jr., and Curran (3, 7) and others (1, 4, 5) have shown that stress from severe threat will degrade performance and that at a given point in time, stress severity is determined by at least three factors: 1) the individual's judgment regarding how soon the harmful event can be expected; 2) his evaluation as to how physically damaging the event will be; and 3) his perception of the probability of its occurring at all. Although these factors are usually defined by conditions beyond individual control, Wherry, Jr., and Curran noted that probabilities can be redefined by the individual if the occurrence of harm depends upon how well he performs and if he knows how well he is performing. This observation was one of several contained in a model of anticipatory physical threat stress (APTS) developed by Wherry, Jr., and Curran. Specifically, they proposed that redefined probability is a multiplicative function of: 1) knowing that harm depends upon performance, and 2) knowing how well one performs. It is important to note that this proposition specifies that probability changes are the product of both the above factors. This was partially confirmed in two studies by Drinkwater et al. (4, 5), who demonstrated that when performance is relevant to the occurrence of harm, subjects perceive a reduction in the probability of being harmed, and their performance improves accordingly. Although in one of these studies (5) subjects were not provided with information regarding performance quality, some feedback appeared to be supplied by the task itself. Nonetheless, the effect of relevance was small, which led the authors to conclude that relevance is not so important a parameter in threat situations as was originally outlined by Wherry, Jr., and Curran.

The importance of relevance, however, may not necessarily be reflected only by reductions in the perceived likelihood of harm (stress). Certain situations exist in which potential hazards are to an extent influenced by performance quality and yet where, given minimally acceptable performance, probabilities of harm remain essentially unchanged. In such situations, performance relevance should still have an effect, not upon the probability of harm (since probabilities remain unchanged), but upon individual ability to resist stress. This distinction, between how much threat one perceives and how one responds to it, was originally made by Wherry, Jr., and Curran (7), and validated by Coulter and Overman (1) who found that amount of threat, established by probability level, varied directly with performance, while response to stress could be measured independently in terms of deviations from the normal course of performance across time (performance shape). In searching for evidence of reduction in stress magnitude, Drinkwater and Flint (5) examined performance level only; they might also have obtained evidence of increased ability to resist stress if positive trends in performance across time had been measured.

The present study, in which both stress magnitude (performance level) and stress reactivity (performance shape) were measured, was designed to determine the effect of various combinations of relevance and feedback upon stress reactivity (in particular, stress resistance). The test structure

was such that it was possible to hold stress magnitude constant so that these effects could be examined with reference to stress reactivity alone. The study was also designed to determine whether analogous effects would occur in situations involving anticipation without physical threat.

HYPOTHESIS

It was hypothesized that when subjects know that harm is imminent, depending upon how well they perform, and when they also know how well they are performing, even though performance level is unaffected, they will display a unique pattern of responses across time under threat, which in relation to other response patterns is characteristic of stress resistance.

PROCEDURE

SUBJECTS

Eighty naval and Marine aviation training candidates were randomly assigned to one of eight groups in order to establish a 2 x 2 x 2 factorial design. An additional ten men were designated as control subjects. The eight groups, and distribution of subject in the groups, were as follows:

No Threat	No Relevance	(No Feedback (NT-NR-NF)	. . . n = 10
		(Feedback (NT-NR-F)	. . . n = 10
	Relevance	(No Feedback (NT-R-NF)	. . . n = 10
		(Feedback (NR-R-F)	. . . n = 10
Threat	No Relevance	(No Feedback (T-NR-NF)	. . . n = 10
		(Feedback (T-NR-F)	. . . n = 10
	Relevance	(No Feedback (T-R-NF)	. . . n = 10
		(Feedback (T-R-F)	. . . n = 10

Controls . . . n = 10

APPARATUS

Each subject was tested individually in a specially constructed experimental booth (6). His arms rested on a console that contained four recessed response keys. Various visual displays (colored lights, alpha-numeric labels) were mounted behind glass panels in front of the subject. These displays were visible only when illuminated, and all illumination was controlled by a UNIVAC 418 II computer by means of programmed instructions. When appropriate, shock was administered through electrodes attached to the subject's forearm via a standard Foringer shock apparatus set at "monkey" strength.

TASK

A 5-minute, subject-paced, four-choice discrimination task was used to measure performance. When one of four possible colors was shown in the display, the correct response was to press a key associated with that color. Once a response was made, whether correct or not, one of the three remaining colors was immediately displayed. The color-key association was established by the use of colored response keys during the first 3 minutes of an initial learning session. Thereafter, the keys were white and subjects were expected to remember the correct relationship. Passage of time was indicated by a series of 30 lights mounted across the top of the display. Starting at the left of the display, one new timing light was turned on every 10 seconds.

METHOD

After hearing taped instructions (Appendix A) regarding the task, all experimental and control subjects took part in a 5-minute learning session, which was followed by a 2-minute rest period.

Experimental subjects were then told that they were to repeat the task but that now they were to be pilots on a simulated mission. New displays (Figure 1) became visible: a "Begin Mission" sign over the first timing light; a "Time Zero" sign between the 18th and 19th light; and an "End Mission" sign over the last light. Subjects also saw a "Probability of Hit" label next to a value of .65.

The threatening situation (T) was created by informing subjects that their mission consisted of dropping a bomb on target at Time Zero. Failure to do so would result in a hit and damage to their aircraft, simulated by a severe electric shock. In the nonthreatening situation (NT), subjects were informed that their mission involved dropping a food package on target at Time Zero. A hit in their mission represented success, which was to be signalled by a bell.

Subjects in the relevant threatening situation (R-T) were told that although the initial probability of failure on the mission was .65, their performance could change this figure. Subjects in the relevant nonthreatening situation (R-NT) were told that although the initial probability of success on the mission was .65, their performance could change this figure. Based upon how well these subjects performed the task, new probabilities would be calculated and displayed every 10 seconds throughout the test. The formula used to recalculate probabilities was such that .65 was the average level for each group (although not necessarily for an individual subject). Subjects in the nonrelevant situation (NR) were informed that the probability of failure for the threatened groups, and probability of success for the nonthreatened groups, was for .65, as displayed, and that ultimate failure or success depended only upon random selection by the computer.

Feedback on performance (F) was explained by telling subjects that, as an aid to performance, their scores would be computed and displayed during each successive 10-second period of the test. No mention of scores was made to subjects receiving no feedback (NF).

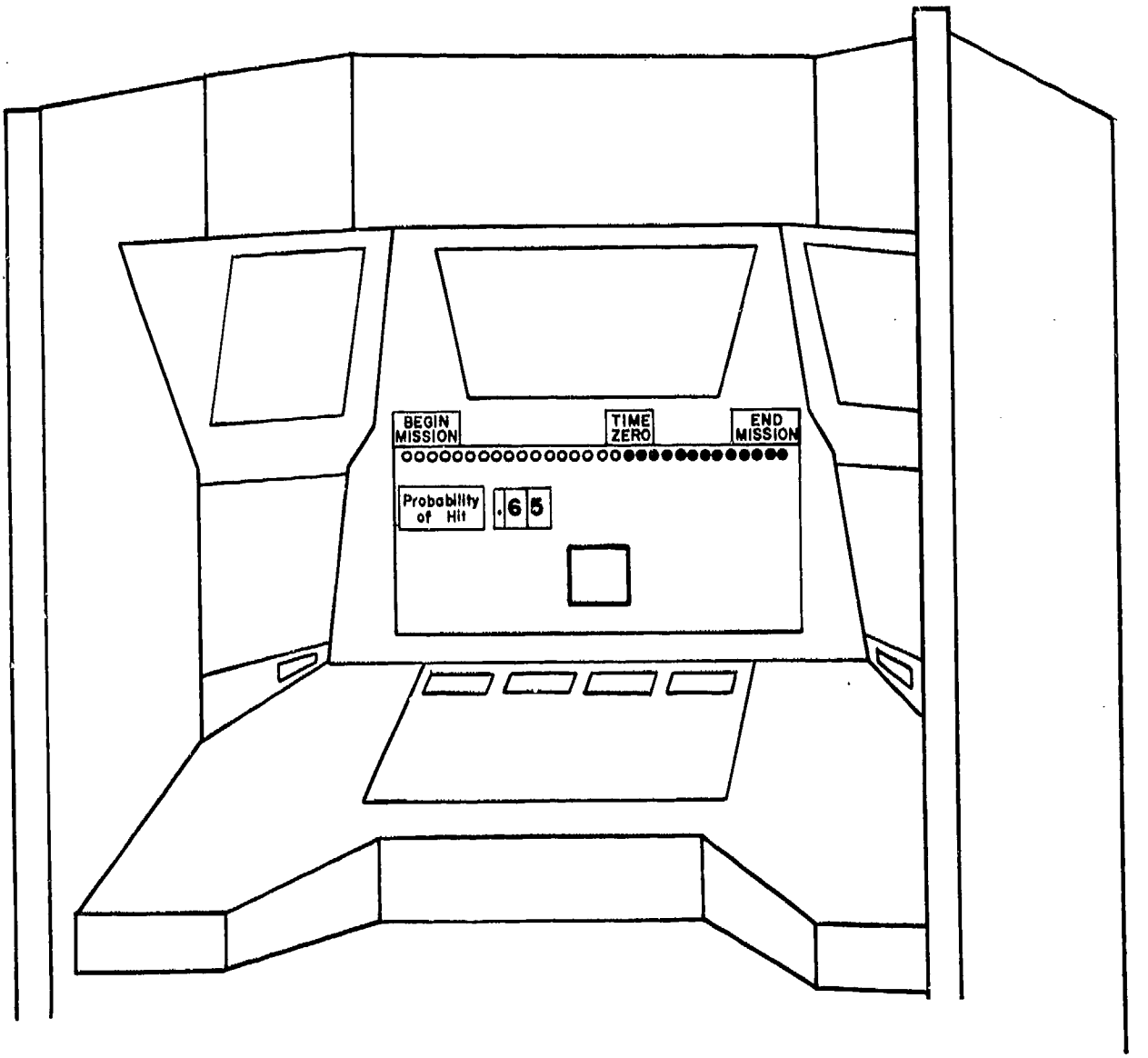

Figure 1

Booth Display As Seen by Experimental Subjects During Session Two

During testing, half of the subjects in each experimental group actually experienced a hit (shock or bell) at Time Zero, regardless of the displayed probability value.

After the rest period that followed the learning session, control subjects were instructed without mention of a simulated mission. Seeing no displays other than those already used during the first session, they were told to simply repeat the task.

ANALYSIS AND RESULTS

SCORING

Each session was divided into 30 successive 10-second periods (blocks), and individual performance was scored in terms of the number of correct responses less the number of incorrect responses (R-W) made during each block. As the best available measure of general task ability, a mean R-W "baseline" score was calculated for each subject from the last blocks of the learning session (blocks 20-29). Table I summarizes these scores for each experimental group and the controls. In order to remove ability differences from the data, the mean baseline score for each subject was then subtracted from each of his R-W scores in the second session. Since in earlier studies (1, 3, 7) significant experimental effects occurred only after the tenth block of the second session, the transformed scores of interest were those from blocks 11 through 18. Subject averages for these blocks were computed and are summarized by group in Table II.

PERFORMANCE LEVEL

Differences in stress level as measured by differences in performance level were tested in a repeated-measures analysis of variance (2). As shown in Table III, the between-subjects analysis failed to show significant differences between threatened and unthreatened groups (A), and contrary to expectations, controls did not differ from experimental subjects. In fact, the data in Table II suggest that the nonthreatened subjects performed at a higher level than both the control and threatened subjects. This observation was confirmed by a comparison test (8, p. 266) which, even when corrected for its a posteriori nature, indicated that this difference was significant at the .01 probability level ($F/2 = 8.27$; $df = 2, 8$).

The significant ABC term indicates that level of performance in any one group depended upon the particular combination of experimental conditions. Since differences in stress severity had not been expected within the four conditions of threat (or of nonthreat), this finding required further study. The data suggest that the ABC interaction was significant because groups with neither feedback nor relevance, and with both, differed from those with only one condition. When both conditions were either present or absent, performance was at a high level in the nonthreatening situation, but at a low level when under threat (see Table II). A comparison test (8, pp. 207-210) showed these differences to be significant at the .01 probability level ($F/7 = 5.45$; $df = 7,81$).

Table I

Summary of "Baseline" Scores for Experimental and Control Subjects

Group	n	Means	S. D.
All Experimental Ss	80	9.78	
All Control Ss	10	10.12	1.08
NT NR NF	10	10.00	1.12
NT NR F	10	9.82	0.81
NT R NF	10	10.08	0.81
NT R F	10	9.83	1.12
All NT Ss	40	9.93	
T NR NF	10	10.11	0.90
T NR F	10	9.11	0.81
T R NF	10	9.70	1.24
T R F	10	9.79	1.05
All T Ss	40	9.68	

Table II

Summary of Session II Scores (Blocks 11 - 18) for Experimental and Control Subjects

Group	n	Means	S. D.
All Experimental Ss	80	0.857	
All Control Ss	10	0.768	1.045
NT NR NF	10	1.262	0.579
NT NR F	10	0.902	0.552
NT R NF	10	0.720	0.850
NT R F	10	1.470	1.077
All NT Ss	40	1.088	
1 NR NF	10	0.262	0.990
T NR F	10	1.215	0.809
T R NF	10	0.538	1.120
T R F	10	0.485	1.881
All T Ss	40	0.625	

Table III

Summary of Results of a Repeated-Measures Analysis of Variance

Source	SS	df	MS	F	P
Between Subjects					
Controls vs All Experimentals	0.2	1	0.2667		
A Threat	32.5803	1	32.5803	3.33	NS
B Relevance	2.3522	1	2.3522		
C Feedback	17.9560	1	17.9560		
AB	1.8490	1	1.8490		
AC	2.0702	1	2.0702		
BC	0.2402	1	0.2402		
ABC	46.6560	1	46.6560	4.77	.05
Error (between)	792.2377	81	9.7807		
Within Subjects					
Controls vs All Experimentals	30.0806	7	4.2972		
D Time Periods	83.7250	7	11.9607	3.50	.01
AD	59.4437	7	8.4920	2.49	.05
BD	20.2937	7	2.8991		
CD	26.3500	7	3.7643		
ABD	30.6250	7	4.3750		
ACD	18.2438	7	2.6062		
BCD	13.1438	7	1.8777		
ABCD	30.7510	7	4.3930		
Error (within)	1936.6614	567	3.4156		

CHANGES IN PERFORMANCE ACROSS TIME

Stress reactivity, defined in terms of performance shape, was tested in the within-subjects part of the analysis (Table III). Under the stated hypothesis, the R-F group under threat was expected to respond to stress by showing a unique pattern of response across time. Although results of the overall within-subjects analysis suggests little with respect to this hypothesis, they do indicate that performance of the experimental groups changed significantly as Time Zero approached. Threatened and unthreatened subjects differed in how they changed (AD), as shown in Figure 2. To specify the nature of these changes required that the data be analyzed for trend (8, pp. 353-369), since R-F performance was expected to show evidence, not of general change, but of some trend characteristic of stress resistance. Only linear, quadratic, and cubic components of the data were selected for analysis since it was believed that little meaning could be attached to performance found to be of any greater complexity. Since the cubic components were not significant, they are omitted from the summary in Table IV.

Results of the linear analysis (Table IV) show that the average slope of the trend lines for all experimental groups was significantly greater than zero and that the slope of the linear trend in the experimental groups was significantly greater than that of the control group. As shown in Figure 3, the control group tended to improve as Time Zero approached, whereas the experimental groups performed more poorly.

Results of the quadratic analysis (Table IV) indicated a significant quadratic component in two of the nonthreatened groups (CD and ACD). Examination of the data suggested that this was due to an increased response rate by the R-F groups during the last two time periods preceding Time Zero. As a result, a test (8, pp. 207-209) compared the quadratic component of the two R-F groups to that of the other six groups (see Figure 4). This test showed a result significant at the .01 level ($F = 8.77$, $df = 1,81$). Furthermore, the threat R-F group differed from the other three threat conditions at the .05 level ($F = 6.39$, $df = 1,81$, but did not differ from the nonthreat condition ($F = 2.74$, $df = 1,71$).

VARIABILITY

Figure 2 suggests that the threatened subjects differed from unthreatened subjects on the rhythm of their responses. In contrast to a rather consistent performance by unthreatened subjects, those under threat appeared to show greater variations in response level from trial to trial. To test this possibility, a variability score was calculated for each subject for blocks 15 through 18 of the second session. This score* quantifies the degree to which the individual fluctuated around his average level. A summary of these variability scores by group is listed in Table V.

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*The formula used to calculate this score is as follows:

$$\text{Individual Variability Score} = \frac{Xi^2 - \frac{(\underline{Xi})^2}{4}}{4} \quad \text{where } i = 15 \text{ through } 18$$

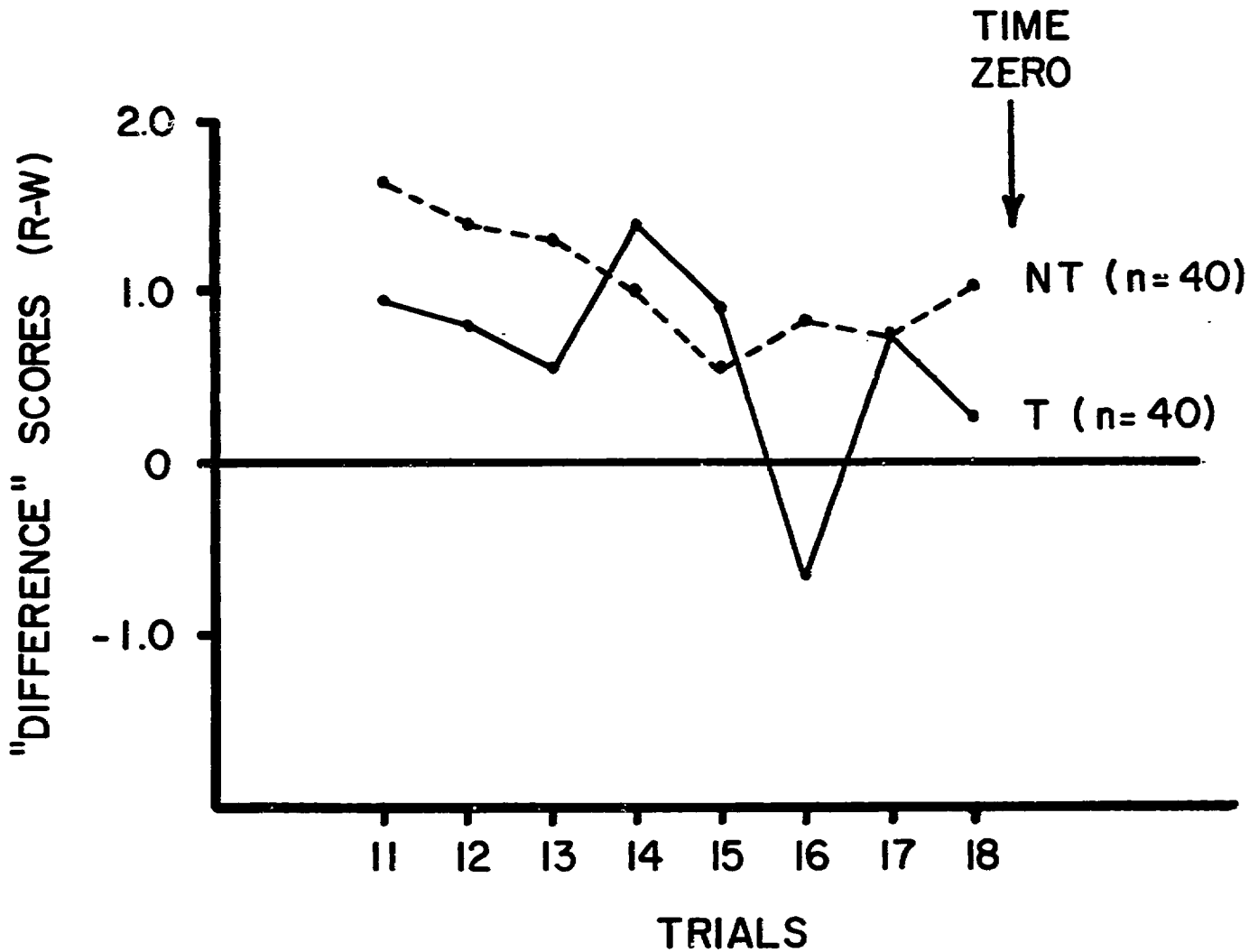

Figure 2

Performance of Threat (n=40) and Nonthreat Groups (n=40)

During the Eight Blocks Prior to Time Zero

Table IV

Summary of Orthogonal Polynomial Trend Analyses

Source	SS	df	MS	F	P
LINEAR TREND (within subjects)					
Controls vs. All Experimentals	13.6383	1	13.6383	4.09	.05
D' TIME-PERIODS	42.9313	1	42.9313	12.88	.01
AD'	0.0013	1	0.0013		
BD'	2.4592	1	2.4592		
CD'	0.2106	1	0.2106		
ABD'	10.8575	1	10.8575	3.26	.10
ACD'	2.8061	1	2.8061		
BCD'	0.0176	1	0.0176		
Error (within)'	269.4464	81	3.3327		
QUADRATIC TREND (within subjects)					
Controls vs. All Experimentals	0.0236	1	0.0236		
D" TIME-PERIODS	4.1370	1	4.1370		
AD"	8.2210	1	8.2210		
BD"	6.1886	1	6.1886		
CD"	20.1347	1	20.1347	6.18	.05
ABD"	0.2732	1	01.2732		
ACD"	10.4744	1	10.4744	3.21	.10
BCD"	5.2330	1	5.2330		
ABCD"	0.6267	1	0.6267		
Error (within)"	264.0712	81	3.2601		

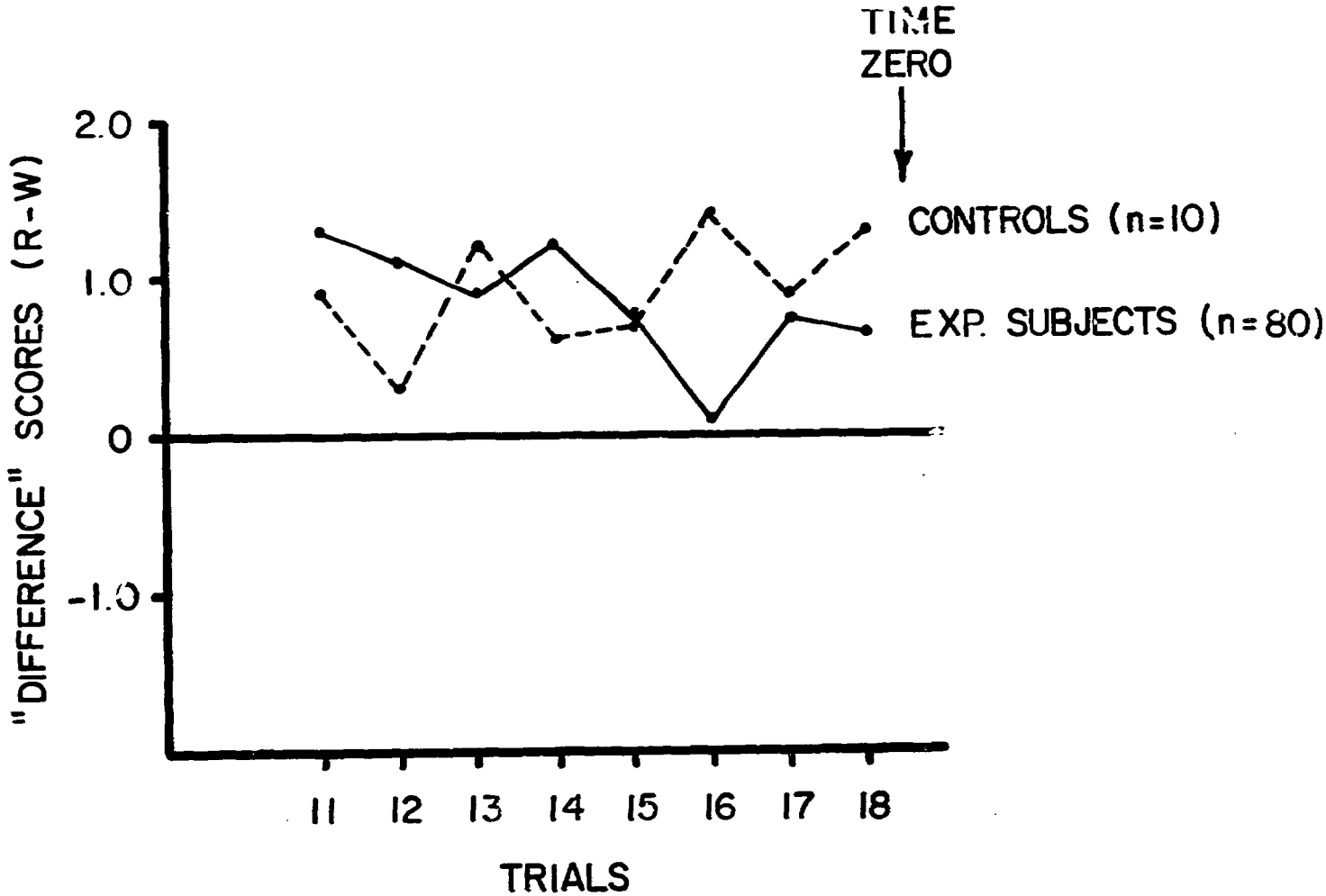

Figure 3

Performance of All Experimental Groups (n=80) as Compared to the Control Group (n=10) During the Eight Blocks Prior to Time Zero

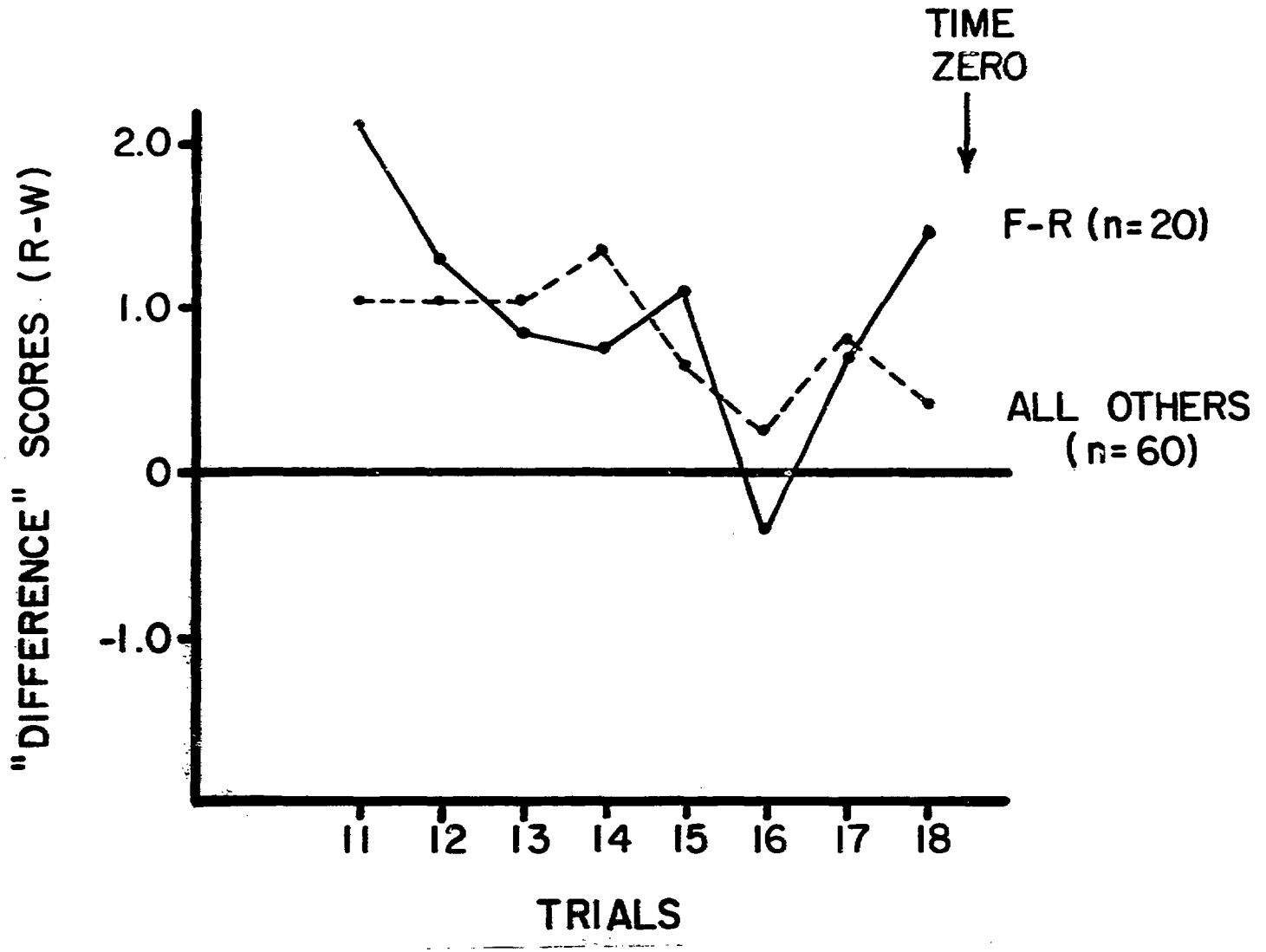

Figure 4

Performance of the F-R Groups (n=20) as Compared to All Other Experimental Groups (n=60) During the Eight Trials Prior to Time Zero

Table V

Summary of Variability Scores for Experimental and Control Subjects

For Trial Blocks 15 Through 18

Group	n	Mean	S.D.
All Experimental Ss	80	3.068	
All Control Ss	10	1.495	1.807
NT NR NF	10	2.714	1.732
NT NR F	10	1.626	0.667
NT R NF	10	2.295	1.442
NT R F	10	2.233	1.576
NT TOTAL	40	2.217	
T NR NF	10	3.495	3.967
T NR F	10	3.320	2.234
T R NF	10	5.145	3.300
T R F	10	3.720	3.490
T TOTAL	40	3.920	

Results of analyzing these scores (Table VI), indicate that, as suggested, threat groups were significantly more variable than the nonthreat groups (A). The variability of the control group was low, although, not significantly lower than the average variability of the experimental groups. A test on this observed trend of increasing variability (8, pp. 273-274), corrected for its a posteriori nature (8, p. 210), proved to be significant at the .01 level ($F/2=9.87$; $df=2,81$).

Table VI

Summary of Analysis of Variance on Variability Scores

Source	SS	df	MS	F	P
Controls vs All Exp.	22.0126	1	22.0126	3.36	
A THREAT	58.0161	1	58.0161	8.85	.01
B RELEVANCE	6.2580	1	6.2580		
C FEEDBACK	9.4511	1	9.4511		
AB	4.3361	1	4.3361		
AC	0.2530	1	0.2530		
BC	0.0631	1	0.0631		
ABC	6.4713	1	6.4713		
Error	530.9403	81	6.5548		

DISCUSSION

HYPOTHESIS

It had been expected that when the probability of being harmed was constant, feedback and relevance together would alter the ability of subjects to resist stress. The presence of both feedback and relevance did result in performance differences over time. (Whereas all groups indicated a general decline in performance over time, the R-F groups had a significant increase in performance during the last two time periods). In conjunction with Drinkwater's results, these findings strongly suggest that the negative effects of threatened harm can be alleviated if the person under threat believes that his performance is relevant to the occurrence of harm and if he knows how well he is performing.

VARIABILITY

Nonthreatened subjects with both feedback and relevance also displayed evidence of stress resistance. If increases in variability reflect increases in stress, then the variability scores show that nonthreatened groups did undergo a certain amount of stress, failling along a continuum from no stress at all in the control group to a rather severe level in the threat groups. Apparently the simple act of anticipation was enough to generate some degree of stress. It would seem that anticipatory physical threat stress, APTS (3, 7), is only one instance of a more general case of anticipatory stress.

PERFORMANCE LEVEL

Intermediate levels of stress improved performance, while both no stress or too much stress degraded it; this is consistent with research on the role of stress in motivation. The discrepancy between the findings for variability and performance level may simply have been due to having failed to make a distinction between stress level per se and stress as a motivator. If this distinction is made, differences obtained within threat and nonthreat conditions become easier to interpret, particularly since those differences were due to various combinations of feedback and relevance, which are known to be motivational parameters. It may be recalled that R-F and NR-NF groups performed at higher levels of performance than the other groups in the nonthreatening situation and at low levels when under threat. The characteristic U-shaped performance curve of motivation suggests that differences in performance level between the threat and nonthreat groups occurred because of stress differences rather than differences in feedback and relevance. The F-R and NF-NR groups in both situations were performing alike and at higher levels of motivation than the NF-R and F-NR groups. Either feedback or relevance alone may have been more confusing than helpful, causing subjects to spend more time extrapolating from the information offered than attending the task at hand. When enough information was supplied, or when there was none, this distracting effort was not necessary, and subjects were then free to perform well or poorly, depending upon the event they were anticipating.

It is of note that this explanation is made without reference to stress level or stress resistance. Whether it is actually correct can be determined only by additional experimentation. What has been made clear, however, is that in future studies, complete analysis requires that performance be examined on three dimensions--shape, level, and variabilities. If the parameters of threat set forth by Wherry, Jr., and Curran (7) are relevant to anticipatory stress in general, an evaluation of the effects of these variables upon all three performance dimensions will clarify the functional relationship between these parameters and performance under stress.

CONCLUSIONS

This study demonstrated that resistance to stress under threat of harm will be enhanced if the occurrence of harm depends upon performance and information is supplied regarding performance quality. This enhancement was present even though the probability of harm (stress magnitude) remained unchanged. Since resistance to stress was also evident when subjects anticipated a nonharmful event, it was suggested that anticipatory physical threat stress (APTS) may be only one instance of anticipatory stress per se. Stress magnitude appeared to be more directly related to performance variability than to performance level. The performance measures of shape, level, and variability may be useful in future studies of anticipatory stresses.

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APPENDIX A

Experimental and Control Instructions

PRACTICE INSTRUCTIONS FOR ALL SUBJECTS

Please make yourself comfortable. There are many displays mounted behind the glass panel in front of you. Since this investigation is only one of many, you will see only those displays appropriate to your task. They are visible when they are lit, and the lighting is controlled entirely by a computer. The investigator is present simply to start the procedures and to answer questions. Because of the computer control, your questions can be answered only at certain clearly specified times. Please use these opportunities when they occur, because otherwise the investigator will not be able to help you.

The task you will be performing is designed to test your ability to receive information and to perform the correct action rapidly and accurately. When the task begins, one of four colors will appear in the display area at about eye level in front of you. Below the display panel are four response keys whose colors correspond to the colors that will be displayed, and which are from left to right, green, red, yellow, and blue. Your job will be to push the response key whose color matches the color being shown. As soon as you press the key, another color will appear and you must press the correct key for that color.

This color-coding is to help you learn which response keys are associated with which colored lights. However, at the end of 3 minutes, the keys will no longer be color-coded and will all change to white. Since the task lasts for 5 minutes, you will have to memorize which response key goes with which color within these first 3 minutes. After the keys turn to white, do not stop or even hesitate until the task is finished and you are told to stop.

The most important thing is to learn to respond to the colors by pressing the correct keys as rapidly and as accurately as possible. Every incorrect response you make is an error, and errors will count against you. Every slow response you make will lower your overall score. The computer will keep a record of every response you make although at this time, you will not be allowed to see this record. If it helps your speed and accuracy, you may use both hands to press the response keys, if you prefer. Do you have any questions about the task itself?

Near the top of the display a light will move across the board from left to right, making one move every 10 seconds. The yellow light you now see is the first step in this series. When the test is past the halfway point, the light will become red for 10 seconds, and then green for the remainder. By noting the position and the color of the light, you can keep track of the time during the test.

To warn you that the task is about to begin, a standby light will soon come on, and at the same time, all other displays will temporarily turn off. After 10 seconds, the standby light will go off, and the first displayed color will appear as well as the color-coded response keys and the timing lights. Immediately begin the task by pressing the correct key for the color shown. Remember to respond to the next color and all succeeding colors as rapidly and as accurately as you can. Also do not forget

that the response keys will turn to white after 3 minutes and that you must memorize the color relationships as soon as possible in order to maintain the proper speed and accuracy. The relationship between the response keys and the displayed colors will remain the same throughout the entire testing period. Do you have any final questions?

All right then, stand by.

POST-PRACTICE INSTRUCTIONS

You may now stop. Please remain seated in front of the display. After a 2-minute rest period, the instructions will continue.

SESSION II INSTRUCTIONS FOR NONTHREATENED SUBJECTS

In this part of the test, you are to be the pilot in a simulated practice flight. To help maintain this simulation, there are now above the timing lights three labels: "Begin Mission," "Time Zero," and "End Mission." It is your mission to fly over a target and to drop a package of food right on target. The food package will hit ground exactly at Time Zero, which occurs immediately after the red timing light goes out.

On the basis of previous experiences, the probability of dropping the package exactly on target is known to be .65, which you can see illuminated in the display panel. The value of .65 is between zero, where there is no chance of hitting target, and 1.0 where it is certain that the target will be hit. In effect, this value means that out of 100 missions, 65 pilots will be successful, while 35 pilots will not. Whether you are one of the lucky or unlucky pilots is to be determined entirely by the computer. The investigator has no control over the probability factors.

Your job is to maintain a good performance throughout the mission on the same task you performed before. As you can see, the keys still correspond to the same colors. The keys, however, will immediately change to white once the test begins. During the mission, think of each color as representing a different task on the aircraft. Your ability to respond accurately and quickly to every color is very important to our assessment of you as a pilot.

For the Feedback Subjects

So that you also can judge how well you are doing, your score will be computed every 10 seconds and will be displayed near the area labeled: "Performance Level."

For the Relevance Subjects

In addition, each of the colors is considered to be critical to the task of navigating the plane toward the target, so that your performance will also directly affect the probability of a hit. Each error or slow response will decrease the probability of a hit, whereas a correct and speedy response will increase the likelihood of a hit. A lower probability value means a lesser chance of dropping the package on target, and a higher

value, a greater chance. The new probability value will be displayed every 10 seconds in the same place that the .65 is now visible.

For the Nonrelevance Subjects

However, since the colors correspond to tasks that are not critical to navigating the plane toward the target, your performance will not affect the probability of a hit. This value will remain constant at .65 throughout the test.

For all Nonthreat Subjects

To let you know whether you have been successful in dropping the food package on target, a hit at Time Zero will be simulated by a bell. Whether the computer sounds the bell or not will be determined by the probability value in effect just prior to Time Zero, a value that will also be visible to you at that time. Do you have any questions about the new instructions?

We are now ready to begin the mission. The standby light will again come on 10 seconds before you are to start. When it goes off, the response keys will change to white, and you should immediately begin the task by pressing the correct key for the color shown in the display. Remember to respond to all colors as rapidly and as accurately as you can.

Do you have any final questions?

All right then, stand by.

SESSION II INSTRUCTIONS FOR THREATENED SUBJECTS

In this part of the test you are to be the pilot in a simulated aircraft flight over enemy territory. To help maintain this simulation, there are now above the timing lights three labels: "Begin Mission," "Time Zero," and "End Mission." It is your mission to fly over an area where there is a large probability of sustaining damage from enemy aircraft. If damage is sustained, it will occur exactly at Time Zero, which is immediately after the red timing light turns off.

On the basis of intelligence information, the probability of being hit at Time Zero is known to be .65, which you can see illuminated in the display panel. The value of .65 is between zero, where there is no chance of sustaining damage, and 1.0 where it is certain that damage will occur. In effect, this value means that out of 100 missions, 65 pilots will probably incur damage, while 35 pilots will not. Whether you are one of the lucky or unlucky pilots is to be determined by the computer. The investigator has no control over the probability factors.

Your job is to maintain a good performance throughout the mission on the same task you performed before. As you can see, the keys still correspond to the same colors. The keys, however, will immediately change to white once the test begins. During the mission, think of each color as re-

presenting a different task on the aircraft. Your ability to respond accurately and quickly to every color is very important to our assessment of you as a pilot.

For the Feedback subjects

So that you can also judge how well you are doing, your score will be computed every 10 seconds and will be displayed near the area labeled: "Performance level."

For the Relevance subjects

In addition, each of the colors is considered to be critical to maintaining the safety of your aircraft, so that your performance will also directly affect the probability of damage. Each error or slow response will increase the probability of a hit, whereas a correct and speedy response will decrease the likelihood of a hit. A lower probability value means a lesser chance of sustaining damage, and a higher value, a greater chance. The new probability value will be displayed every 10 seconds in the same place that the .65 is now visible.

For the Nonrelevance subjects

However, since the colors correspond to tasks that are not critical to maintaining the safety of your aircraft, your performance will not affect the probability of damage. This value will remain at .65 throughout the test.

For all Threat Subjects

The investigator will now attach some electrodes to your arm. If you have any questions, please wait until the instructions are completely finished.

To give you an idea of what to expect, the shock level can be described as being just within the upper limit allowed by the Navy. This means that if your aircraft is damaged at Time Zero, the shock, while it will be harmless and brief, is expected to cause a rather violent involuntary muscle reaction. Now, do you have any questions about the new instructions?

We are now ready to begin the mission. The standby light will again come on 10 seconds before you are to start. When it goes off, the response keys will change to white in the display. Remember to respond to all colors as rapidly and as accurately as you can.

Do you have any final questions?

All right then, stand by.

SESSION II INSTRUCTIONS FOR CONTROL SUBJECTS

In this part of the test, you are to maintain a good performance on

the same task you performed before. As you can see, the keys still correspond to the same colors as before. The keys, however, will immediately change to white once the test begins. Your ability to respond accurately and quickly to every color is still very important. Before you are to start, the standby light will again come on for 10 seconds. When it goes off, the response keys will change to white and you should immediately begin the test by pressing the correct key for the color shown in the display. Remember to respond to all colors as rapidly and as accurately as you can. Do you have any questions?

All right then, stand by.

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13. ABSTRACT

This study sought to demonstrate that, in a threatening situation, if occurrence of harm depends upon performance (relevance) and information is supplied regarding performance quality (feedback), resistance to stress will be enhanced even though stress magnitude (probability of harm) remains unchanged. Eighty aviation officer candidates were experimental subjects; ten others were controls. A subject-paced, four-choice discrimination task was used, and all subjects were allowed an initial 5-minute practice session. Subjects anticipated either a noxious event (electric shock) or a benign event (bell). Within each condition, four groups performed the task, each with a different combination of feedback and relevance: with neither, with both, or with one or the other. Controls simply performed the task a second time. Results indicated that: 1) anticipation in itself may be stressful; 2) measured by changes in performance across time, stress resistance is enhanced by both feedback and relevance; 3) stress magnitude is best measured by performance variability; and 4) performance level, which is related by a U-shaped function to stress, may reflect motivational aspects of stress.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Threat						
Stress						
Anticipatory physical threat stress						
Psychomotor performance measures						